

MINI-FOCUS ISSUE: ELECTROPHYSIOLOGY

ADVANCED

CASE REPORT: CLINICAL CASE

# Coronary Injury Caused by Endocardial Ablation in Midanterior Septum of the Right Ventricle



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## ABSTRACT

Coronary injury or spasm induced by endocardial radiofrequency catheter ablation in the right ventricle (RV) has been rarely reported. We introduce a case of coronary injury from a young patient who underwent catheter ablation for idiopathic ventricular arrhythmia originating from the RV septum. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2022;4:101628) © 2022 Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## HISTORY OF PRESENTATION

A 24-year-old female patient without prior heart disease was admitted and referred for catheter ablation therapy for her frequent, symptomatic monomorphic premature ventricular contractions (PVCs) with a Holter burden of 15.5% refractory to several antiarrhythmic drugs including propafenone 450 mg/day or metoprolol 95 mg/day. Preprocedural echocardiography showed no obvious structural or functional abnormality with an ejection fraction of 68%. Surface electrocardiogram (ECG) featured a Qr pattern in leads I and aVL, a qR pattern in lead II, an R pattern in leads III and aVF, with a late R-wave transition at V<sub>6</sub>.

## LEARNING OBJECTIVES

- To understand the neighboring anatomy of the right ventricular septum.
- To be aware of the potential risk of coronary artery injury when performing endocardial ablation at the right ventricular septum.

## INTERVENTIONS

Endocardial electroanatomic mapping and fluoroscopic imaging revealed a midanterior septal origin in the right ventricle (RV) (**Figure 1**). Bipolar electrograms indicated a 38-ms ventricular electrogram QRS interval at the earliest activation site, with a QS unipolar pattern and a satisfying pace mapping match. Radiofrequency energy application (35 W/52°C/120 s) with an open-irrigated ablation catheter (ThermoCool SmartTouch, Biosense Webster) was delivered to suppress the arrhythmia successfully.

However, the patient complained of chest distress after the ablation energy delivery. The ECG showed prominent ST-segment elevation in anteroseptal leads (more than 0.4 mV in leads V<sub>2</sub> and V<sub>3</sub>) (**Figure 2A**). Other vital signs were stable. A transfemoral coronary angiography performed immediately revealed acute occlusion of the mid-distal segment of the left anterior descending (LAD) artery (**Figure 2B1**). Antegrade flow was restored after intracoronary injection of nitroglycerin and verapamil via a microcatheter (**Figure 2B2**). Then the

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**ABBREVIATIONS  
AND ACRONYMS****ECG** = electrocardiogram**LAD** = left anterior descending**PVC** = premature ventricular contraction**RV** = right ventricle

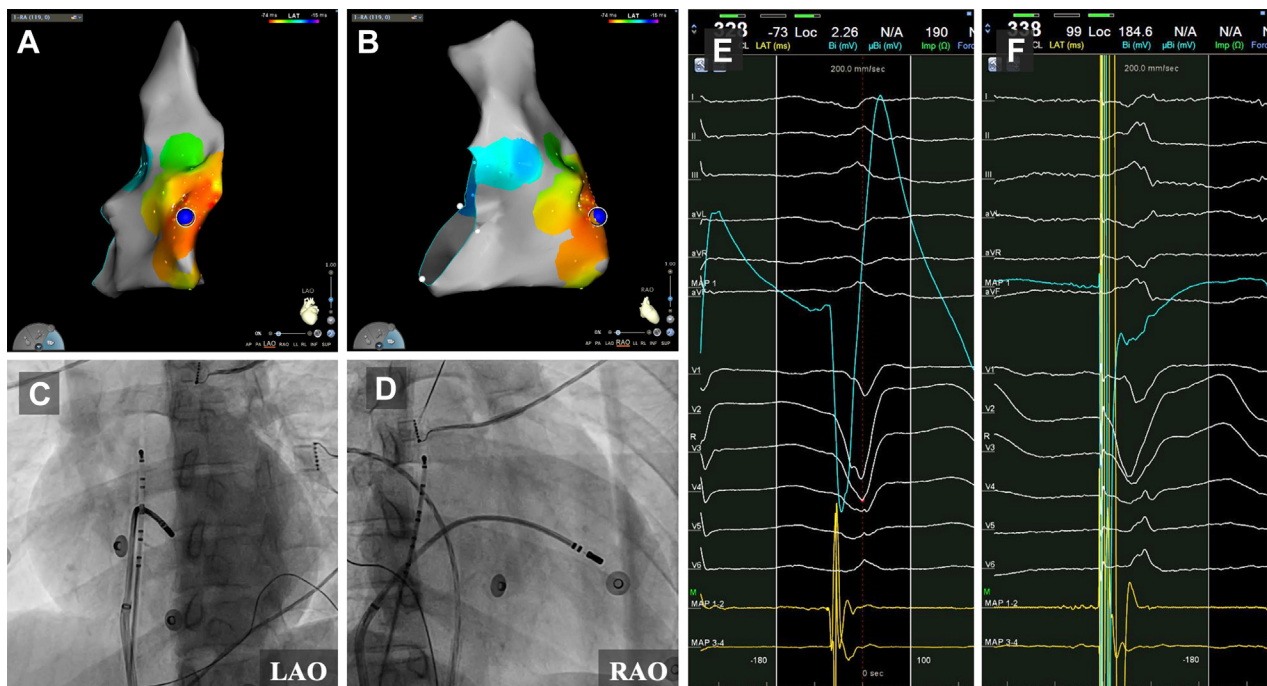
stenotic segment was dilated with a 2.0 × 15-mm balloon, and remission of symptoms and ST-segment resolution were achieved when the LAD flow reached thrombolysis in myocardial infarction grade 3 (Figures 2B3 and 2B4). A transient elevation of troponin I (peak value of 2.51 ng/mL) was documented after the procedure. Postprocedural ECG and Holter monitor showed sinus rhythm without any ventricular arrhythmia. A regimen of 1-month dual-antiplatelet therapy of aspirin (100 mg once daily) plus clopidogrel (75 mg once daily) was prescribed.

**DISCUSSION**

To our knowledge, coronary artery injury or spasm caused by endocardial ablation in the RV has been seldomly reported.

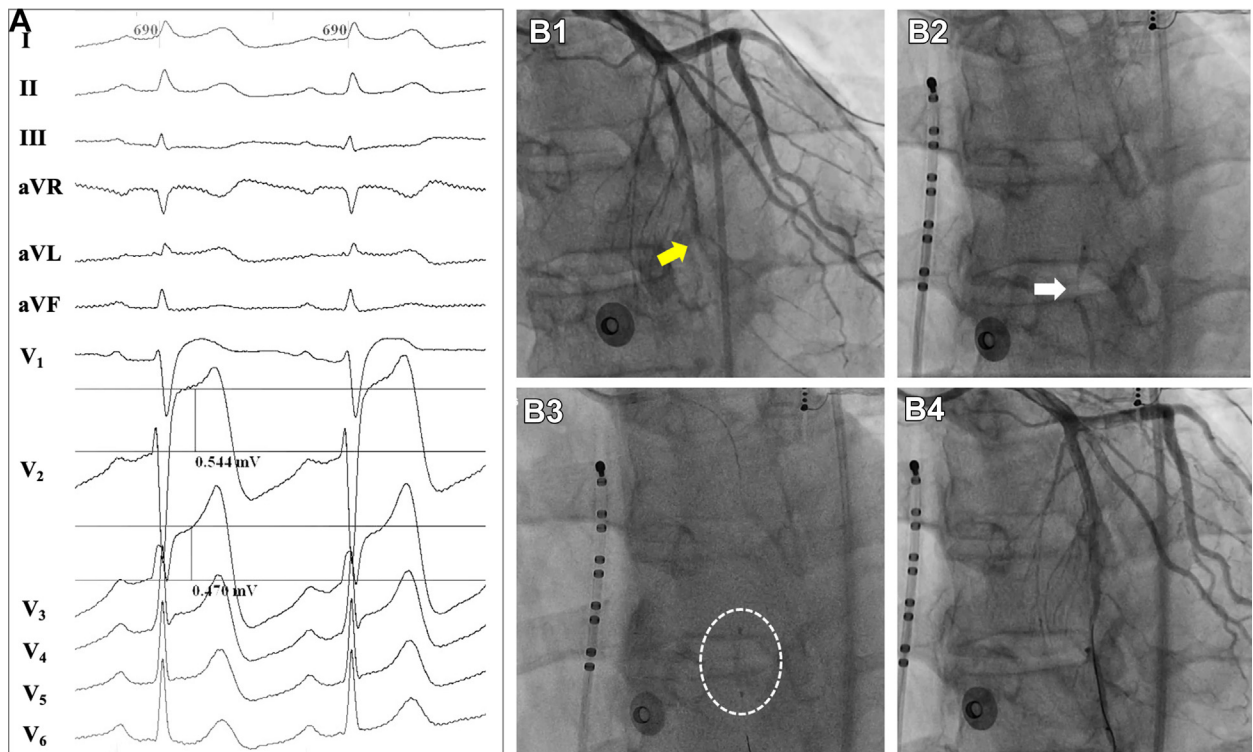
Coronary arteries course along the epicardium. Theoretically, vasospasm or injuries such as

dissection or stenosis could be induced by direct thermal trauma when the ablation energy is delivered close to the epicardial vessels. It is safe to eliminate idiopathic ventricular arrhythmias originated from endocardium except for the close proximity to some specific anatomic structures. Kimata et al<sup>1</sup> reported a case of PVC-induced cardiomyopathy with its origin at the left ventricular outlet tract. It did not deliver energy at the earliest activation site in the distal great cardiac vein because of the high impedance. Alternative ablation at the left ventricular endocardium using an irrigated catheter with an intensive energy of 50 W resulted in complete elimination of the PVCs. However, a prominent stenosis at the first diagonal branch of the LAD was revealed by angiography without any symptom or ST-T change to the patient. A diagnosis of coronary spasm was considered because the stenosis could be diminished after intracoronary injection of vasodilators (nicorandil plus nitroglycerin). The distance between target site

**FIGURE 1** PVC Mapping Before Ablation

Endocardial activation map showed the earliest activation (blue dot) at the midanterior septum of the right ventricle from the left anterior oblique (LAO) view (A) and right anterior oblique (RAO) view (B) with their corresponding fluoroscopic images (C and D), respectively. (E) Bipolar and unipolar records revealed a 38-ms ventricular electrogram QRS interval at the target site. (F) Pace mapping showed a satisfying match result with a 0.977 morphologic matching value. PVC = premature ventricular contraction.

**FIGURE 2** Coronary Injury and Management



Twelve-lead electrocardiogram showed obvious elevation of ST segments in precordial leads (most prominent in  $V_2$  and  $V_3$ ) after ablation at the earliest activation site in the midanterior septum of the right ventricle (A). Immediate coronary angiography revealed the occlusion of the mid-distal segment of the left anterior descending artery (B1, yellow arrow) which caused the patient chest distress. Blood flow restored after the intracoronary injection of nitroglycerin and verapamil through the microcatheter (B2, white arrow). Relief of the chest distress and the ST-segment resolution were observed after transluminal coronary angioplasty with a  $2.0 \times 15$ -mm balloon (B3, white dash circle). Thrombolysis in myocardial infarction grade 3 coronary flow was recorded (B4).

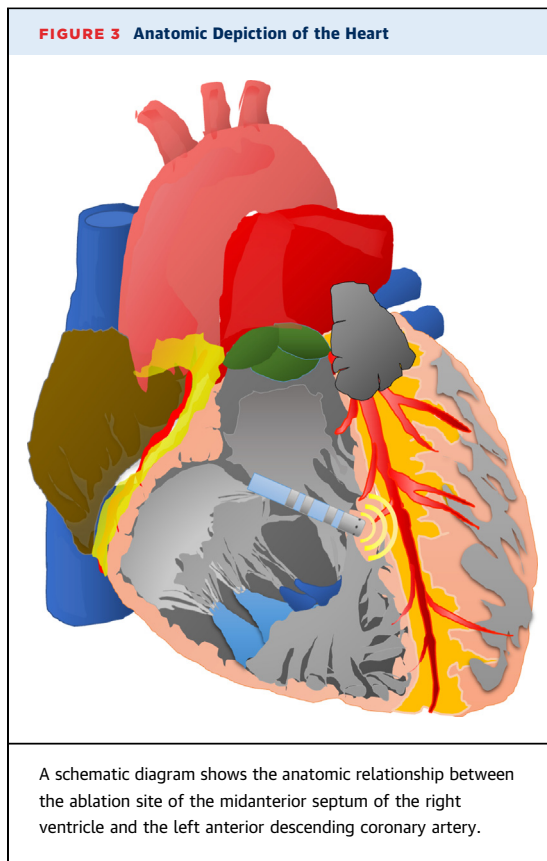
and coronary artery was only 9 mm. Radiofrequency energy could cause acute dissection or delayed obstruction of the left main coronary artery which could only be solved by implantation of drug-eluting stents.<sup>2</sup> Another ventricular structure that is prone to ablation-induced vessel injury is the inaccessible area of the left ventricular summit. Elimination of the arrhythmia could be achieved by cryoablation at the distal aspect of the great cardiac vein. However, an inevitable but reversible vasospasm of the left circumflex coronary artery without ST-segment elevation or chest pain was recorded.<sup>3</sup>

Although the earliest activation site was in the endocardial aspect of the RV in our case, we could not exclude the presence of diverticulum or trabeculated interventricular septum close to the mid-distal LAD

(Figure 3). There were no advanced imaging modalities such as intracardiac echocardiography, cardiac magnetic resonance, or superimposition of the fluoroscopic images and electroanatomic geometry applied to evaluate the distance between the ablation site and the LAD vessel. In addition, the thickness of the RV septum was not measured because no structure abnormality was found in preprocedural echocardiography. In addition, intravascular ultrasound could not be performed to explore the stenosis based on the patient's refusal.

#### FOLLOW-UP

Three weeks later the patient was admitted for an episode of 4-hour chest pain. ECG showed sinus



rhythm and transient ST-segment elevations in leads V<sub>2</sub> to V<sub>4</sub> without any correlated abnormal biomarker change. No advanced stenosis at the mid-distal LAD or other vessels was observed during a redo angiography. Coronary spasm of the LAD was diagnosed and nicorandil was prescribed. Neither further symptoms nor arrhythmia was recorded during the follow-up.

### CONCLUSIONS

Thermal trauma and epicardial coronary artery injury could happen inadvertently when radiofrequency energy is delivered at the midanterior septum of the RV. Intracoronary angiography and interventional therapy are helpful for diagnosis and treatment.

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### REFERENCES

1. Kimata A, Igarashi M, Yoshida K, et al. Left anterior descending artery spasm after radiofrequency catheter ablation for ventricular premature contractions originating from the left ventricular outflow tract. *HeartRhythm Case Rep*. 2015;1:103-106.
2. Kaneko U, Kashima Y, Kanno D, et al. Delayed left main coronary artery obstruction after radiofrequency-induced coronary dissection and spasm: insights from optical frequency-domain imaging and intravascular ultrasound imaging. *J Am Coll Cardiol Intv*. 2017;10:2009-2011.
3. Rivera S, Paz Ricapito Mdl, Parodi J, et al. Coronary artery vasospasm during catheter cryoablation of left ventricular summit nonsustained ventricular tachycardia. *HeartRhythm Case Rep*. 2016;2:491-494.

**KEY WORDS** coronary injury, endocardial ablation, premature ventricular contract